Transmittal Letter to the United States Designated/Elected Office (DO/EO/US)

10/009153

JC18 Rec'd PCT/PTO 0 1 DEC 2001

Docket No.	:	**HM-463PCT**
U.S. Application No	.	
International Application No		**PCT/EP00/05216**
International Filing Date.	:	**June 7, 2000**
Priority Date Claimed	·	**June 7, 1999**
Title of Invention		**AUTOMATION OF A HIGH-SPEED CONTINUOUS CASTING PLANT**
Applicant(s) for (DO/EO/US)	.	**Fritz-Peter Pleschiutschnigg, Stephan Feldhaus, Lothar Parschat, Michael Vonderbank, Thomas Ulke, Robert Victor Kowalewski, Rolf-Peter Heidemann**

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. X This is a FIRST submission of items concerning a filing under 35 U.S.C 371.
2. ___ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U S C 371.
3. X This express request to begin national examination procedures 35 U.S.C. 371 (f) at any time rather than delay examination until the expiration of the applicable time limit set forth in 35 U.S C 371(b) and PCT Articles 22 and 39(1)
4. ___ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date
5. X A copy of the International Application as filed [35 U.S C 371(c)(2)],
   a) X is transmitted herewith (required only if not transmitted by the International Bureau).
   b) ___ has been transmitted by the international Bureau.
   c) ___ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. X A translation of the International Application into English [35 U S C 371(c)(2)].
7. ___ Amendments to the claims of the International Application under PCT Article 19 [35 U.S.C 371(c)(3)]
   a) ___ are transmitted herewith (required only if not transmitted by the International Bureau).
   b) ___ have been transmitted by the International Bureau
   c) ___ have not been made, however, the time limit for making such amendments has **NOT** expired.
   d) ___ have not been made and will not be made.
8. ___ A translation of the amendments to the claims under PCT Article 19 [35 U S.C 371(c)(3)].
9. X An oath or declaration of the inventor(s) [35 U S.C 371(c)(4)]. **UNSIGNED**
10. ___ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 [35 U S C 371(c)(5)].

Items 11. to 16. below concern other document(s) or information included:

11. X An Information Disclosure Statement under 37 C.F.R. 1 97 and 198.
12. ___ An Assignment document for recording A separate cover sheet in compliance with 37 CFR 3 28 and 3.31 is included
13. X A FIRST preliminary amendment
    ___ A SECOND or SUBSEQUENT preliminary amendment
14. ___ A substitute specification
15. ___ A change of power of attorney and/or address letter.
16. X (other items or information) **Seven sheets of drawings, PTO-1449 w/ 5 references and International Search Report**

EXPRESS MAIL No · **EL 862 852 022 US** Deposited: **December 1, 2001**

I hereby certify that this correspondence is being deposited with the United States Postal Service Express mail under 37 CFR 1 10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington, DC 20231

Fr Kueffner

Friedrich Kueffner

December 1, 2001
Date

10/009153

U.S. Application No. (if known, see 37 C F.R. 1.50):
International Application No. PCT/EP00/05216

JC10 Rec'd PCT/PTO 01 DEC 2001

Docket No. HM-483PCT

17. X The following fees are submitted:

	CALCUL-ATIONS	PTO USE ONLY
BASIC NATIONAL FEE [37 CFR 1.492(a)(1)-(5)]:		
X Search Report has been prepared by the EPO or JPO .... **$ 890.00**		
___ International preliminary examination fee paid to USPTO [37 CFR 1.482] .... **$ 710.00**		
___ No International preliminary examination fee paid to USPTO [37 CFR 1.482] but International search fee paid to USPTO [37CFR 1.445(a)(2) ...... **$ 740.00**		
___ Neither International preliminary examination fee [37 CFR 1.482] nor International search fee [37 CFR 1.445(a)(2]) paid to USPTO .... **$ 1040.00**		
___ International preliminary examination fee paid to USPTO [37 CFR 1 482] and all claims satisfied provisions of PCT Article 33 (2) to (4): ...... **$ 100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT:	$ 890.00	
Surcharge of $ 130 00 for furnishing the oath or declaration later than ___20 ___30 months from the earliest claimed priority date [37 CFR 1.492(e)]	$	
Claims / filed / Extra / Rate		
Total Claims / 5 / -20= / x $ 18.=	$	
Indep. Claims / 1 / - 3= / x $ 84.=	$	
Multiple Dependent Claims (if applicable) + $ 280.=	$	
TOTAL OF ABOVE CALCULATIONS:	$ 890.00	
Reduction by ½ for filing by small entity, if applicable. Verified Small Entity Statement must be filed also [Note 37 CFR 1.9,1 27, 1.28] (divided by 2)		
SUBTOTAL:	$ 890.00	
Processing fee of $ 130 00 for furnishing the English Translation later than ___20 ___30 months from the earliest claimed priority date [37 CFR 1.492(f)]	$	
TOTAL NATIONAL FEE:	$ 890.00	
Fee for recording the enclosed assignment [37 CFR 1 21(h)] The assignment must be accompanied by an appropriate cover sheet [37 CFR 3.28,3.31]. **$ 40.00 per property**	$	
TOTAL FEES ENCLOSED:	$ 890.00	
AMOUNT TO BE REFUNDED:	Refunded	$
AMOUNT TO BE CHARGED:	Charged	$

a) X A check in the amount of **$ 890.00** to cover the above fees is enclosed.

b) _ Please charge my Deposit Account No. 11-1835 in the amount of $ to cover the above fees A duplicate copy of this sheet is enclosed

c) X The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **11-1835** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 36 CFR 1.494 or 1.495 has not been met, a petition to revive [37 CFR 1 137(a) or (b)] must be filed and granted to restore the application to pending status

SEND ALL CORRESPONDENCE TO:

Friedrich Kueffner
342 Madison Avenue
Suite 1921
New York, NY 10173

Friedrich Kueffner	F. Kueffner	29,482	December 1, 2001
Name	signature	Reg. No.	Date

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

HM-463PCT

Applicant(s)	:	Fritz-Peter Pleschiutschnigg, et al
Serial No.	:	NOT YET KNOWN (PCT/EP00/05216)
Int. Filed	:	June 7, 2000
For	:	AUTOMATION OF A HIGH-SPEED CONTINUOUS CASTING PLANT

Assistant Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

S I R:

In advance of the first office action, please amend the claims as follows:

IN THE CLAIMS

Replace current claims 1 - 9 by the enclosed amended claims 1 - 9. A marked-up version of amended claims 1 - 9 is also enclosed.

REMARKS

Claims 1 - 9 are in the application.

Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 11-1835.

Respectfully submitted,

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December 1, 2001
FK:ml
ENCLS:
Amended Claims;
Marked-Up Version.

EXPRESS MAIL No.: **EL 862 852 022 US** Deposited: **December 1, 2001**

I hereby certify that this correspondence is being deposited with the United States Postal Service Express mail under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington, DC 20231.

Friedrich Kueffner

CLEAN VERSION OF AMENDED CLAIMS

1. Method for operating a high-speed continuous casting plant for casting a metallic strand (1.7), in particular, a slab, with casting speeds of maximally 10 m/min., comprising an oscillating casting mold (1) which comprises oppositely positioned casting mold narrows sides (1.2.1, 1.2.2) and faces (1.3.1, 1.3.2), in particular comprised of copper plates, wherein molten mass flows via a submerged exit nozzle (1.5) or a nozzle from a distributor (6) into the casting mold (1) and the distributor (6) comprises a movable stopper (6.1) or a slide closure for regulating the inflowing molten mass quantity, wherein the method is operated with or without casting powder (1.6),

   and wherein for determining the actual casting state the following parameters are measured during the casting process (online):

   - meniscus level (9) of the molten mass in the casting mold (1) in mm/min.,
   - temperature (6.2) of the molten mass in the distributor (6) over the casting time,
   - actual casting speed in m/min over the casting time,

   wherein furthermore the following is measured:

   - stopper or slide closure movement (6.1.1) as a measure for the oxidic purity over the casting time,

- heat flow via the casting mold faces (WF; WL),
- heat flow via the casting mold narrow sides (NO; ND) in MW/m^2 over the casting time,

and that changes of the actual casting state are determined based on the stopper or slide closure movement, the meniscus movement as well as the change of the heat flows via the casting mold faces over a predetermined time interval, and

that, should the changes be within a predetermined nominal interval, operation is switched to automated casting operation, which includes

comparison of the heat flow ratios of each individual narrow side or face for an adjustment of the narrow side conicity, in particular, the narrow side copper plate conicity, relative to one another for a correction in relation to the heat flows via the faces,

adjustment of a maximum possible casting speed as a function of melting temperature in the distributor and the corresponding material to be cast

or that, should the changes of at least one some of or all of the parameters for determining the casting state be outside of a predetermined nominal interval, a semi-automatic control of the

angular adjustment of the casting mold narrows sides as well as the casting speed is maintained.

2. Method according to claim 1, wherein, after switching has been carried out to an automated operation upon surpassing predetermined limits of changes of the casting parameters, an alarm (11.2) is triggered and operation is switched back to a semi-automated operation.

3. Method according to claim 1, wherein the dependency of the melting temperature in the distributor and the maximum possible casting speed is set for each steel group, for example, "low carbon", "medium carbon", and "high carbon".

4. Method according to claim 1, wherein the heat flows per surface unit of the fixed side as well as the loose side of the casting mold faces (W) are measured and that the heat flows per surface unit of the operating side (NO) and drive side (ND) of the casting mold narrows sides are measured, that the changes of the respectively measured values are determined over a predetermined casting time interval, and, should the changes of at least some of the recorded values be within a predetermined limit interval, switching to an automated operation is carried out, wherein the limit interval is defined by:

the change of the stopper movement is maximally ± 2 mm/time unit,

the change of the meniscus level is maximally ± 5 mm/time unit, the change of the heat flows of the casting mold faces is maximally ± 0.10 MW/m^2 absolute and relative to one another,

that the heat flow ratio of the narrow sides to the faces is as follows

$$0.9 > NO/W,\ ND/W > 0.4$$

after completion of switching to automated operation, regulating the angular adjustments of the narrow sides by means of controlling the adjusting cylinder so that the ratio of the heat flows of the narrow sides over the faces is within the following limit interval

$$0.8 > NO/W,\ ND/W > 0.6,$$

measuring the actual melting temperature in the distributor, controlling the maximum permissible casting speed as a function of the melting temperature and the alloy composition.

5. Method according to claim 4, wherein the correction of the angular adjustment of the narrow sides is carried out automatically in steps of 0.1 mm/adjusting action.

6. Method according to claim 1, wherein, in addition to the alloy composition, the casting powder is also used as a parameter in the control of the maximum permissible casting speed.

7. System for performing the method according to claim 1, which is provided in a high-speed continuous casting plant for casting a metallic strand (1.7) in particular a slab, with casting speeds of maximally 10 m/min., comprising an oscillating casting mold (1) which comprises oppositely positioned casting mold narrows sides (1.2.1, 1.2.2) and faces (1.3.1, 1.3.2), in particular comprised of copper plates, which can be controlled during casting by means of adjusting cylinders (1.2.3) with regard to their conicity, wherein molten mass flows via a submerged exit nozzle (1.5) or a nozzle from a distributor (6) into the casting mold (1) and the distributor (6) has a movable stopper (6.1) or a slide closure for regulating the inflowing molten mass quantity, optionally employing casting powder (1.6),

comprising means for measuring the meniscus movement(9),
a continuous or discontinuous measuring device for measuring the melting temperature in the distributor (6.2),
comprising means for measuring the actual casting speed (1.8) of the strand, in particular, the slab, as well as a computing unit (10) for determining the changes of the casting process over a predetermined casting time interval as well as for comparing the changes with predetermined limits (10.1),
wherein it comprises furthermore the following:
means for measuring the stopper or slide closure movement (6.1.1),
means for measuring the face heat flow (7) of the fixed side and

the loose side,
means for measuring the narrow side heat flows (8) of the operating side and the drive side,
means (1.2.3) for changing the angular position of the conically arranged two narrow sides of the casting mold as well as
means for changing the casting speed,
wherein the means for changing the angular position of the narrow sides as well as the means for changing the casting speed can be automatically controlled as a function of the result of the computing unit (10) or can be controlled semi-automatically.

8. System according to claim 7, wherein alarm means (11.2) which are activated upon surpassing the predetermined limits based on the computed changes of the measured values and means for switching back the automatic operation to a semi-automated operation.

9. System according to claim 7, wherein a joystick (11) is provided as an operating means for semi-automatic control of the casting speed and/or the angular position of at least one of the two casting mold narrow sides (12, 13).

MARKED-UP VERSION OF AMENDED CLAIMS

1. Method for operating a high-speed continuous casting plant for casting a metallic strand (1.7), in particular, a slab, with casting speeds of maximally 10 m/min., comprising an oscillating casting mold (1) which comprises oppositely positioned casting mold narrows sides (1.2.1, 1.2.2) and faces (1.3.1, 1.3.2), in particular comprised of copper plates, wherein molten mass flows via a submerged exit nozzle (1.5) or a nozzle from a distributor (6) into the casting mold (1) and the distributor (6) comprises a movable stopper (6.1) or a slide closure for regulating the inflowing molten mass quantity, wherein the method is operated with or without casting powder (1.6),

   and wherein for determining the actual casting state the following parameters are measured during the casting process (online):

   - meniscus level (9) of the molten mass in the casting mold (1) in mm/min.,
   - temperature (6.2) of the molten mass in the distributor (6) over the casting time,
   - actual casting speed in m/min over the casting time,

   [characterized in that] <u>wherein</u>

   furthermore the following is measured:

   - stopper or slide closure movement (6.1.1) as a measure for the oxidic purity over the casting time,

- heat flow via the casting mold faces (WF; WL),
- heat flow via the casting mold narrow sides (NO; ND) in MW/m^2 over the casting time,

and that changes of the actual casting state are determined based on the stopper or slide closure movement, the meniscus movement as well as the change of the heat flows via the casting mold faces over a predetermined time interval, and

that, should the changes be within a predetermined nominal interval, operation is switched to automated casting operation, which includes

comparison of the heat flow ratios of each individual narrow side or face for an adjustment of the narrow side conicity, in particular, the narrow side copper plate conicity, relative to one another for a correction in relation to the heat flows via the faces,

adjustment of a maximum possible casting speed as a function of melting temperature in the distributor and the corresponding material to be cast

or that, should the changes of at least one some of or all of the parameters for determining the casting state be outside of a predetermined nominal interval, a semi-automatic control of the angular adjustment of the casting mold narrows sides as well as the casting speed is maintained.

2. Method according to claim 1,
[characterized in that] <u>wherein</u>,
after switching has been carried out to an automated operation upon surpassing predetermined limits of changes of the casting parameters, an alarm (11.2) is triggered and operation is switched back to a semi-automated operation.

3. Method according to [claim 1 and 2,
characterized in that] <u>claim 1, wherein</u>
the dependency of the melting temperature in the distributor and the maximum possible casting speed is set for each steel group, for example, "low carbon", "medium carbon", and "high carbon".

4. Method according to [one of the claims 1 to 3,
characterized in that] <u>claim 1, wherein</u>
the heat flows per surface unit of the fixed side as well as the

loose side of the casting mold faces (W) are measured and that the heat flows per surface unit of the operating side (NO) and drive side (ND) of the casting mold narrows sides are measured, that the changes of the respectively measured values are determined over a predetermined casting time interval, and, should the changes of at least some of the recorded values be within a predetermined limit interval, switching to an automated operation is carried out, wherein the limit interval is defined by:

the change of the stopper movement is maximally $\pm$ 2 mm/time unit,

the change of the meniscus level is maximally $\pm$ 5 mm/time unit,

the change of the heat flows of the casting mold faces is maximally $\pm$ 0.10 MW/m^2 absolute and relative to one another,

that the heat flow ratio of the narrow sides to the faces is as follows

$$0.9 > NO/W,\ ND/W > 0.4$$

after completion of switching to automated operation,

regulating the angular adjustments of the narrow sides by means of controlling the adjusting cylinder so that the ratio of the heat flows of the narrow sides over the faces is within the following limit interval

$$0.8 > NO/W,\ ND/W > 0.6,$$

measuring the actual melting temperature in the distributor,

controlling the maximum permissible casting speed as a function of the melting temperature and the alloy composition.

5. Method according to claim 4, [characterized in that] wherein the correction of the angular adjustment of the narrow sides is carried out automatically in steps of 0.1 mm/adjusting action.

6. Method according to [one of the claims 1 to 5, characterized in that] claim 1, wherein, in addition to the alloy composition, the casting powder is also used as a parameter in the control of the maximum permissible casting speed.

7. System for performing the method according to [one of the claims 1 to 6] claim 1, which is provided in a high-speed continuous casting plant for casting a metallic strand (1.7) in particular a slab, with casting speeds of maximally 10 m/min., comprising an oscillating casting mold (1) which comprises oppositely positioned casting mold narrows sides (1.2.1, 1.2.2) and faces (1.3.1, 1.3.2), in particular comprised of copper plates, which can be controlled during casting by means of adjusting cylinders (1.2.3) with regard to their conicity, wherein molten mass flows via a submerged exit nozzle (1.5) or a nozzle from a distributor (6) into the casting mold (1) and the distributor (6) has a movable stopper (6.1) or a slide closure for regulating the inflowing molten mass quantity, optionally employing casting powder (1.6),

comprising means for measuring the meniscus movement(9),

a continuous or discontinuous measuring device for measuring the melting temperature in the distributor (6.2),

comprising means for measuring the actual casting speed (1.8) of the strand, in particular, the slab,

as well as a computing unit (10) for determining the changes of the casting process over a predetermined casting time interval as well as for comparing the changes with predetermined limits (10.1),

[characterized in that] wherein

it comprises furthermore the following:

means for measuring the stopper or slide closure movement (6.1.1),

means for measuring the face heat flow (7) of the fixed side and the loose side,

means for measuring the narrow side heat flows (8) of the operating side and the drive side,

means (1.2.3) for changing the angular position of the conically arranged two narrow sides of the casting mold as well as

means for changing the casting speed,

wherein the means for changing the angular position of the narrow sides as well as the means for changing the casting speed can be automatically controlled as a function of the result of the computing unit (10) or can be controlled semi-automatically.

8. System according to claim 7,

[characterized in that] <u>wherein</u>

alarm means (11.2) which are activated upon surpassing the predetermined limits based on the computed changes of the measured values and means for switching back the automatic operation to a semi-automated operation.

9. System according to [claim 7 or 8,

characterized in that] <u>claim 7, wherein</u>

a joystick (11) is provided as an operating means for semi-automatic control of the casting speed and/or the angular position of at least one of the two casting mold narrow sides (12, 13).

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Translation of WO 00/74878 (PCT/EP00/05216) with Amended Pages and Claims Incorporated Therein

Method and System for Operating a High-Speed Continuous Casting Plant

The invention relates to a method according to the preamble of claim 1 as well as to a system according to the preamble of claim 7. Particularly for the operation of high-speed plants for slabs and, in this connection, particularly in combination with rolling mills, it is important to be able to operate the continuous casting plant at a high and controlled speed in a safe way.

This necessity of safety for casting particularly at high casting speeds up to 10 m/min. makes it necessary to carry out control of numerous processing data, which are intermeshed in a complex fashion with one another, by means of automation.

This automation must be reduced with respect to its external operation language to a simple functional language which is easily manageable by the operating personnel.

Moreover, the degree of automation, which in regard to its operating language knows only the selection of casting speed and the control all of the narrow side heat flow at the operator (NO) or drive (ND) side, should provide the possibility of operation by autopilot when certain conditions such as

- a controlled steel temperature in the distributor
- a good oxidic purity of the steel

- a calm meniscus as well as
- a constant and uniform heat flow of the faces

are present.

The prior art discloses the measuring of the heat flows of all four copper plates of a slab casting mold (DE 4117073) but in this patent document no prior art as a function of the casting speed is disclosed. For example, a speed increase has a minimal effect on the casting mold stress, expressed as MW/m^2, and a great effect on the strand shell stress expressed as MWh/m^2.

Figure 1 shows this correlation and illustrates that at high casting speeds, when using casting powder and a certain castings speed of, for example, > 4.5 m/min., the casting mold stress remains almost constant and the strand shell stress is greatly reduced. The reason for this is that at high casting speed a constant slag film and thus a constant heat transfer occurs but a residence time of the strand shell within the casting mold decreases proportionally to the casting speed increase. This illustration makes clear that with increasing casting speed the casting mold stress no longer increases and the casting shell stress decreases so that the risk of fracture formation is reduced but also the casting shell becomes thinner and hotter, for example, at the end of the casting mold.

In Figure 2, the interrelationships are represented between
- casting slag film,
- the strand shell temperature, for example, at the exit of the casting mold, strand shell thickness, and shrinkage,
- casting mold and strand shell stresses or shrinkage,

- maximum casting mold skin temperature at the meniscus and thus of the casting mold service life in relation to the re-crystallization temperature which results in softening of the cold-rolled copper.

US-A-3 478 808 discloses a method for controlling the parameters of a continuous casting plant for casting steel. Nominal values of parameters, which have been taken from a previous casting process, are stored; actual values of the parameters are recorded, an adjustment of the actual and nominal values is carried out, and a control of the parameters is performed. The disclosed parameters are inter alia the flow speed, the heat removal rate within the casting mold and the removal speed.

Based on this, it is an object of the invention to further develop a method and a system for performing the method for a controlled operation of a continuous casting plant for casting slab, in particular, thin slab, with very high casting speeds.

This object is solved with the method according to the features of claim 1 and a system with the features of claim 7. Advantageous embodiments are disclosed in the dependent claims.

An automation of the continuous casting process based on an "online" data acquisition is made possible which enables in addition to

- a semi-automation, i.e., the control of the narrow side conicity and the casting speed, also
- a full automation in the sense of an autopilot operation

with consideration and as a function of the steel temperature in the distributor and with the prerequisite of a controlled

- purity,
- meniscus, and
- face heat flow.

This object is solved by the features of the method claim 1 and the device claim with their dependent claims for configuring the invention.

The Figures are provided as examples for illustrating the invention and are described in the following. It is shown in:

Figure 1 the casting mold and strand shell stress as a function of the casting speed

Figure 2 the interrelationships between the casting speed and
- the slag film thickness
- the strand shell temperature, shrinkage as well as trend shell thickness at the exit of the casting mold,
- casting mold and strand shell stress as well as shrinkage,
- temperature stress of the copper plates at the meniscus as well as service life of the copper plates relative to the recrystallization temperature of the cold-rolled copper plate.

The Figures 1 and 2 have already been described in detail as prior art and are provided for a better understanding of the following

description which is not to be viewed as being obvious to a person skilled in the art and thus includes an inventive step.

Figure 3 illustrates

a) a slab casting mold (1) with (1.1) and without pouring hopper and in regard to its conicity and adjustable narrow sides (1.2) as well as submerged exit nozzle (1.4) and casting powder

b) the casting mold stress, expressed as MW/m2 for faces (WL) and (WF) as well as for the narrow sides (ND) and (NO) over the casting time and

c) the relationship of the heat flows from the faces to the narrow sides, expressed as NO/WL, NO/WF and ND/WL, NO/WF, which describe the course of the heat flows more simply and facilitate their correction over the conicity adjustment during casting.

Figure 4 shows the casting situations A, B, C with the aid of

a) the heat flows, expressed as MW/m^2 or

b) the relationship of the heat flows ND/WF, ND/WL and NO/WF, NO/WL, which experience a correction by adjustment of the narrow sides in their conicity from the position 0 to the position 1.

Figure 5 illustrates the temperature course of molten masses in the distributor over a casting time of one hour.

Figure 6 illustrates the casting window defined by the steel temperature in the distributor and the casting speed with exemplary temperature courses of different molten masses.

Figure 7 illustrates the data acquisition and the control circuit in the area of the continuous casting plant with the input of limits for the control and regulation of the narrow side conicities and the maximum casting speed as a function of the steel temperature in the distributor.

Figure 3 is comprised of the partial Figures a), b), and c). Figure 3 a) illustrates schematically a slab or bloom casting mold (1), comprised of two individual narrow sides (1.2), which are provided at the operating side (1.2.1) (NO) and drive side (1.2.2) (ND) with adjusting cylinders (1.2.3), and two faces (1.3), respectively, the backside (1.3.1) (WF), and the loose side (1.3.2) (WL).

The casting mold (1) furthermore can advantageously be provided with a pouring hopper (1.1). The liquid steel (1.4) is introduced through the submerged exit nozzle (1.5) below the bath level (1.7.2) in the casting mold when using a casting powder (1.6) with formation of casting slag (1.6.1) and a casting slag film between the casting mold (1) and the strand shell (1.7.1), which is provided for lubrication and heat flow control.

Figures 3 b) and c) show the specific course of heat flow in MW/m^2 of the faces WF, WL (1.3.2) and the narrow sides NO (1.2.1), NO (1.2.2) in the normal, uneventful casting process, wherein the casting time from the beginning to the time tx at which the steel is within temperature equilibrium. The narrow side flows must have over the conicity adjustment of the narrow sides a ratio to the faces of < 1 which must be maintained constant over the casting time.

Different slag films formed across the strand circumference, especially between the faces and the narrow sides, different casting speeds, different steel temperatures, non-uniform flow conditions in the left and the right half of the casting mold, a deflection of the slab from the strand center axis in the casting direction can cause deviations in regard to the specific heat dissipation.

These deviations are illustrated in Figure 4 with the aid of three typical situations A, B and C (Figure 4) by means of the specific heat flows, expressed as MW/m^2 in Figure 4 b) and as a heat flow ratio narrow side/faces (N/W) in Figure 4 c).

In the situation A, the heat flow of the narrow side deviates at the drive side (ND) (1.2.2) from that of the narrow side at the thickness side (NO) (1.2.1) by a heat flow that is too small. With a greater adjustment of the conicity at the narrow side from position 0 to position 1, the heat flow is adjusted to that of the narrow side (NO).

In the situation B, the heat flows of both narrow sides are too great in comparison to the faces. By reducing the conicity adjustment of both narrow sides from the position 0 to the position 1, the heat flows are brought into the correct ratio relative to the faces.

In the situation C, the heat flows of the narrow sides are too small and can be adjusted to the correct value relative to the faces by a simultaneous enlargement of the narrow side conicity from the position 0 to the position 1.

Figure 5 represents the temperature course of numerous molten masses over a time period of approximately 1 hour in the distributor. It can be seen that, for example, in these ladles with a molten mass contents of approximately 180 t the steel temperature drops by approximately 5 °C/hour. This drop of the steel temperature in the distributor can be kept relatively small and depends substantially on

- the residence time of the steel in the distributor, i.e., the casting output and
- the insulation of the distributor.

The absolute temperature with which the steel flows into the distributor is predetermined by the continuous casting operation, is adjusted by the steel mill and depends on, for example,

- ladle transport times,
- ladle age and
- ladle lining,

which result often in deviations from the nominal temperature because of an uncontrolled operation process.

Figure 6 represents the casting window defined by the steel temperature in the distributor and the maximum possible casting speed.

The casting window (4) is defined by an upper (3.0) and a lower (3.1) temperature limit. Moreover, in addition to the steel temperature in the casting mold (3.3), the area of the liquidus temperature (3.4) of, for example, low-carbon steel qualities, is

illustrated. The steel temperature in the casting mold increases for a constant steel temperature in the distributor with

- greater distributor volume,
- improved distributor insulation,
- use of magneto-electro brake in the casting mold.

The Figure 6 represents three molten masses with different distributor temperatures and thus different maximum possible casting speeds, but, for example, identical temperature loss of 5 °C/hour.

In detail, these three situation in the casting window (4) are as follows.

In the case (4.1), the steel temperature at the start of casting is 1,570 °C and makes possible a maximum casting speed (1.8) of 4.0 m/min., and after 1 hour casting time at the end of the ladle casting time the steel temperature of 1,565 °C allows for a maximum casting speed of 4.5 m/min.

In the case (4.2), the steel temperature in the distributor at the start of casting of the melt is 1,560 °C and at the end of casting 1,555 °C which makes possible a maximum casting speed of 5.0 m/min. and of 5.85 m/min. at the end of casting.

In the case (4.3), the temperature is 1,550 °C and makes possible a casting speed of 7.2 m/min. and at the end of casting, with a temperature of 1,545 °C, a casting speed of > 8m/min. The speed of a maximum of 8 m/min. can be adjusted when reaching a temperature of approximately 1,548 °C.

Figure 7 illustrates the configuration of a semi-automation or a full automation/autopilot for casting in a high speed plant.

The device is comprised of a steel ladle (5), a distributor (6) with a stopper or slide closure (6.1) as well as a discontinuous or continuous temperature measurement in the distributor, a continuous casting plant with oscillating casting mold (1) and adjustable narrow sides (12) as well as removal rollers (6.3) which are driven by a motor (6.3.1) and which remove the strand at a controlled casting speed (1.8).

The following data acquisition is required for a full automation/autopilot:

- temperature measurement of the steel in the distributor (6.2) in °C;
- stopper movement or slide movement (6.1.1) in dy/dt;
- heat flow measurement of the faces (7) in MW/m^2;
- heat flow measurement of the narrow sides (8) in MW/m^2;
- stopper movement
- movement of the meniscus (9) in dx/dt; and
- actual casting speed (1.8) in m/min.

These data are compared in an online computer (10) with the limits. With preconditions such as

- a stopper movement of dy/dt of ± 0, i.e., a "clean steel" which does not lead to a significant oxidic deposition within the SEN as well as to no stopper and SEN erosion,
- a constant heat flow, within the faces at constant casting speed with a tolerance of a maximum of 0.1 MW/m^2 over the casting time and relative to one another,

- a meniscus movement of a maximum of $\pm$ 5 mm for a casting time of 60 seconds,
- a heat flow ratio of the narrow sides to the faces of > 0.9 and < 0.4

the system interface (11) in the form of a "joystick" having the four functions

- +/- casting speed and
- +/- taper for the individual narrow sides

and representing a semi-automation, can be switched to full automation or the status of autopilot in an operatively safe and thus breakout-free way (< 0.5 percent).

The full automation corrects with the casting operation the conicity adjustments of each individual narrow side based on the heat flow ratios between the narrow sides and the faces outside of a narrow side/faces ratio of, for example,

$$0.8 > \frac{N}{W} > 0.5.$$

and automatically adjusts the maximum possible casting speed which is possible as a result of the steel temperature in the distributor and the provided equation.

The invention makes possible a reproducible operation of the continuous casting plant with maximum possible productivity and controlled strand quality while avoiding breakout.

List of Reference Numerals

(1)	slab casting mold with oscillation
(1.1)	hopper
(1.2)	narrow sides of casting mold
(1.2.1)	narrow side of the operator side (NO)
(1.2.2)	narrow side of the drive side (ND)
(1.2.3)	adjusting cylinder
(1.3)	faces
(1.3.1)	face, fixed, or backside, WF
(1.3.2)	face loose side or backside, WL
(1.4)	liquid steel
(1.5)	submerged entry nozzle, SEN
(1.6)	casting powder
(1.6.1.1)	casting slag film between casting mold and strand shell
(1.7)	strand
(1.7.1)	strand shell
(1.7.2)	meniscus
(1.8)	casting speed, V_c
(1.8.1)	casting time t_x, after which the steel temperature is in equilibrium with the distributor
(3)	upper temperature limit
(3.1)	lower temperature limit
(3.3)	steel temperature in the casting mold
(3.4)	area of the liquidus temperature of "low carbon" steel qualities
(3.5)	causes of an increase of the steel temperature in the casting mold at controlled temperature of the steel in the distributor inlet
(4)	casting window with three molten masses of different temperatures in the distributor and identical temperature

loss of 5 °C/hour in the casting window of steel temperature/casting speed

(4.1) situation 1 with a molten mass which results in a steel temperature in the distributor of 1,570 °C at the start of casting and 1,565 °C at the end of casting and allows for a casting speed of 4.0 and a maximum of 4.5 m/min.

(4.2) situation 2 with a molten mass which results in a steel temperature in the distributor of 1,560 °C at the beginning of casting and 1,560 °C at the end of casting and allows a casting speed of 5.0 and a maximum of 5.85 m/min

(4.3) situation 3 with the molten mass results in a steel temperature in the distributor of 1,500 °C at the start of casting and 1,545 °C at the end of casting and allows a casting speed of 7.0 and > 8.0 m/min

(5) steel ladle

(6) distributor

(6.1) stopper or slide closure

(6.1.1) stopper or slide movement

(6.2) discontinuous or continuous temperature measurement of the steel in the distributor

(6.3) driven removal rollers

(6.3.1) drive motor

(7) heat flow measurement in MW/m^2 of the faces

(7.1) faces of the backside, fixed side WF

(7.2) faces of the loose side, WL

(8) heat flow measurement in MW/m2 of the narrow sides

(8.1) heat flow measurement of the operator side (NO)

(8.2) heat flow measurement of the drive side (ND)

(8.3) heat flow ratio narrow sides/faces

(8.3.1) heat flow ratio operator-narrow side/faces (NO, NO)

(WL WF)

(8.3.2) heat flow ratio drive narrow side/faces $\frac{(ND,\ NO)}{(WL\ WF)}$

(9) meniscus movement dx/dt

(10) online computer

(10.1) limits

(11) system interface "joystick"

(11.1) full automation/autopilot status

(11.2) alarm for taking over in semi-automation

Claims

1. Method for operating a high-speed continuous casting plant for casting a metallic strand (1.7), in particular, a slab, with casting speeds of maximally 10 m/min., comprising an oscillating casting mold (1) which comprises oppositely positioned casting mold narrows sides (1.2.1, 1.2.2) and faces (1.3.1, 1.3.2), in particular comprised of copper plates, wherein molten mass flows via a submerged exit nozzle (1.5) or a nozzle from a distributor (6) into the casting mold (1) and the distributor (6) comprises a movable stopper (6.1) or a slide closure for regulating the inflowing molten mass quantity, wherein the method is operated with or without casting powder (1.6),

   and wherein for determining the actual casting state the following parameters are measured during the casting process (online):

   - meniscus level (9) of the molten mass in the casting mold (1) in mm/min.,
   - temperature (6.2) of the molten mass in the distributor (6) over the casting time,
   - actual casting speed in m/min over the casting time,

   characterized in that

   furthermore the following is measured:

   - stopper or slide closure movement (6.1.1) as a measure for the oxidic purity over the casting time,
   - heat flow via the casting mold faces (WF; WL),
   - heat flow via the casting mold narrow sides (NO; ND) in MW/m^2 over the casting time,

   and that changes of the actual casting state are determined based on the stopper or slide closure movement, the meniscus

movement as well as the change of the heat flows via the casting mold faces over a predetermined time interval, and

that, should the changes be within a predetermined nominal interval, operation is switched to automated casting operation, which includes

comparison of the heat flow ratios of each individual narrow side or face for an adjustment of the narrow side conicity, in particular, the narrow side copper plate conicity, relative to one another for a correction in relation to the heat flows via the faces,

adjustment of a maximum possible casting speed as a function of melting temperature in the distributor and the corresponding material to be cast

or that, should the changes of at least one some of or all of the parameters for determining the casting state be outside of a predetermined nominal interval, a semi-automatic control of the angular adjustment of the casting mold narrows sides as well as the casting speed is maintained.

2. Method according to claim 1,
characterized in that,
after switching has been carried out to an automated operation upon surpassing predetermined limits of changes of the casting parameters, an alarm (11.2) is triggered and operation is switched back to a semi-automated operation.

3. Method according to claim 1 and 2,

characterized in that
the dependency of the melting temperature in the distributor and the maximum possible casting speed is set for each steel group, for example, "low carbon", "medium carbon", and "high carbon".

4. Method according to one of the claims 1 to 3, characterized in that
the heat flows per surface unit of the fixed side as well as the loose side of the casting mold faces (W) are measured and that the heat flows per surface unit of the operating side (NO) and drive side (ND) of the casting mold narrows sides are measured,
that the changes of the respectively measured values are determined over a predetermined casting time interval, and, should the changes of at least some of the recorded values be within a predetermined limit interval, switching to an automated operation is carried out, wherein the limit interval is defined by:
the change of the stopper movement is maximally ± 2 mm/time unit,
the change of the meniscus level is maximally ± 5 mm/time unit,
the change of the heat flows of the casting mold faces is maximally ± 0.10 MW/m^2 absolute and relative to one another,
that the heat flow ratio of the narrow sides to the faces is as follows

$$0.9 > NO/W,\ ND/W > 0.4$$

after completion of switching to automated operation,
regulating the angular adjustments of the narrow sides by means of controlling the adjusting cylinder so that the ratio

of the heat flows of the narrow sides over the faces is within the following limit interval

$$0.8 > NO/W,\ ND/W > 0.6,$$

measuring the actual melting temperature in the distributor, controlling the maximum permissible casting speed as a function of the melting temperature and the alloy composition.

5. Method according to claim 4, characterized in that the correction of the angular adjustment of the narrow sides is carried out automatically in steps of 0.1 mm/adjusting action.

6. Method according to one of the claims 1 to 5, characterized in that, in addition to the alloy composition, the casting powder is also used as a parameter in the control of the maximum permissible casting speed.

7. System for performing the method according to one of the claims 1 to 6, which is provided in a high-speed continuous casting plant for casting a metallic strand (1.7) in particular a slab, with casting speeds of maximally 10 m/min., comprising an oscillating casting mold (1) which comprises oppositely positioned casting mold narrows sides (1.2.1, 1.2.2) and faces (1.3.1, 1.3.2), in particular comprised of copper plates, which can be controlled during casting by means of adjusting cylinders (1.2.3) with regard to their conicity, wherein molten mass flows via a submerged exit nozzle (1.5) or a nozzle from a distributor (6) into the casting mold (1) and

the distributor (6) has a movable stopper (6.1) or a slide closure for regulating the inflowing molten mass quantity, optionally employing casting powder (1.6),

comprising means for measuring the meniscus movement(9),

a continuous or discontinuous measuring device for measuring the melting temperature in the distributor (6.2),

comprising means for measuring the actual casting speed (1.8) of the strand, in particular, the slab,

as well as a computing unit (10) for determining the changes of the casting process over a predetermined casting time interval as well as for comparing the changes with predetermined limits (10.1),

characterized in that

it comprises furthermore the following:

means for measuring the stopper or slide closure movement (6.1.1),

means for measuring the face heat flow (7) of the fixed side and the loose side,

means for measuring the narrow side heat flows (8) of the operating side and the drive side,

means (1.2.3) for changing the angular position of the conically arranged two narrow sides of the casting mold as well as

means for changing the casting speed,

wherein the means for changing the angular position of the narrow sides as well as the means for changing the casting speed can be automatically controlled as a function of the result of the computing unit (10) or can be controlled semi-automatically.

8. System according to claim 7,

characterized in that
alarm means (11.2) which are activated upon surpassing the predetermined limits based on the computed changes of the measured values and means for switching back the automatic operation to a semi-automated operation.

9. System according to claim 7 or 8,
characterized in that
a joystick (11) is provided as an operating means for semi-automatic control of the casting speed and/or the angular position of at least one of the two casting mold narrow sides (12, 13).

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

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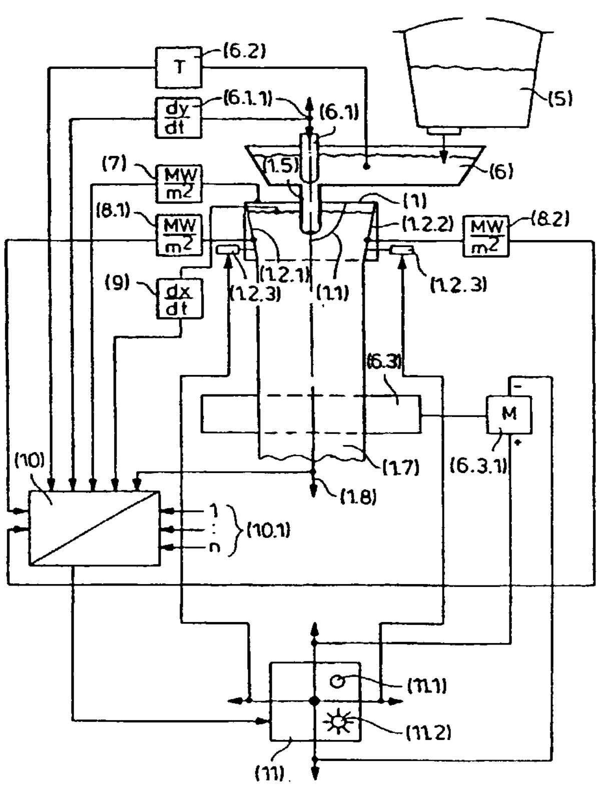
[Fortsetzung auf der nächsten Seite]

(54) Title: AUTOMATION OF A HIGH-SPEED CONTINUOUS CASTING PLANT

(54) Bezeichnung: AUTOMATISIERUNG EINER HOCHGESCHWINDIGKEITS-STRANGGIESSANLAGE



(57) Abstract: The invention relates to a method for automatically operating a high-speed continuous casting plant. According to said method, the stopping or slide movement, the modification of the steel level, the heat currents through the mold walls, the temperature of the liquid metal and the drawing-off speed are measured over the casting time, supplied to a computer and compared with predetermined limit values for an automatic operating mode.

(57) Zusammenfassung: Verfahren zum automatischen Betreiben einer Hochgeschwindigkeits- Stranggiessanlage, bei dem die Stopfen- oder Schieberbewegung, die Veränderung der Badspiegelhöhe, die Wärmeströme durch die Kokillenwände, die Temperatur des flüssigen Metalls und die Abzugsgeschwindigkeit über die Giesszeit gemessen, einem Rechner zugeführt und mit vorgegebenen Grenzwerten für eine automatische Betriebsweise verglichen werden.

WO 00/74878 A1

Fig.1

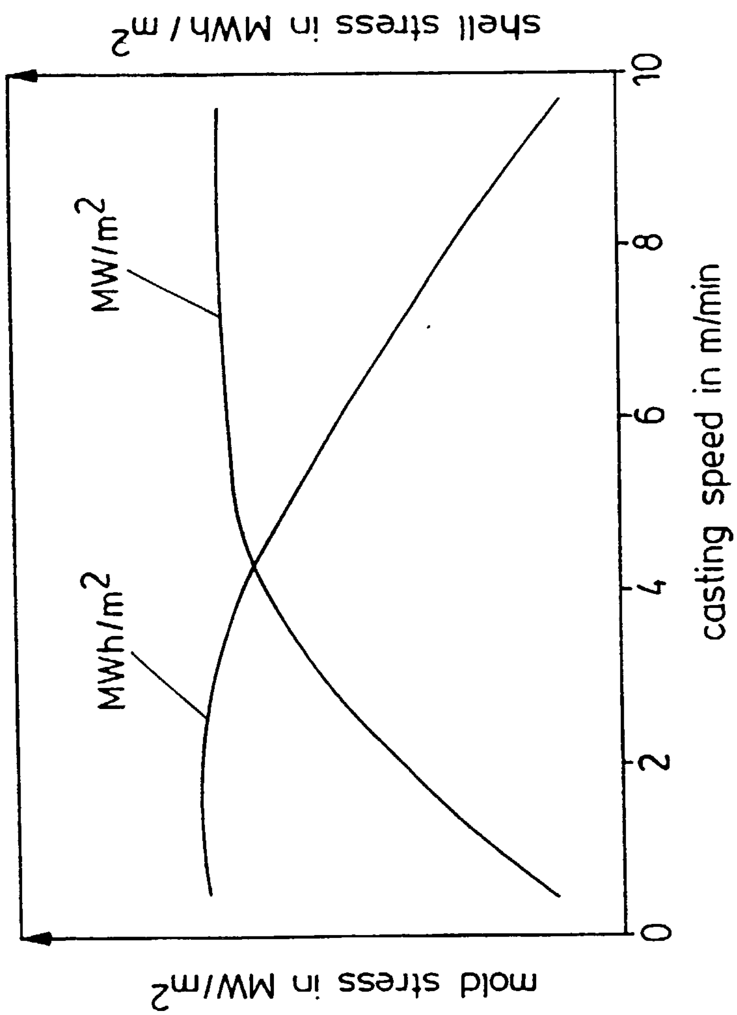

shell stress in MWh / m2
mold stress in MW/m2
casting speed in m/min
0
2
4
6
8
10
MW/m2
MWh/m2

Fig. 2

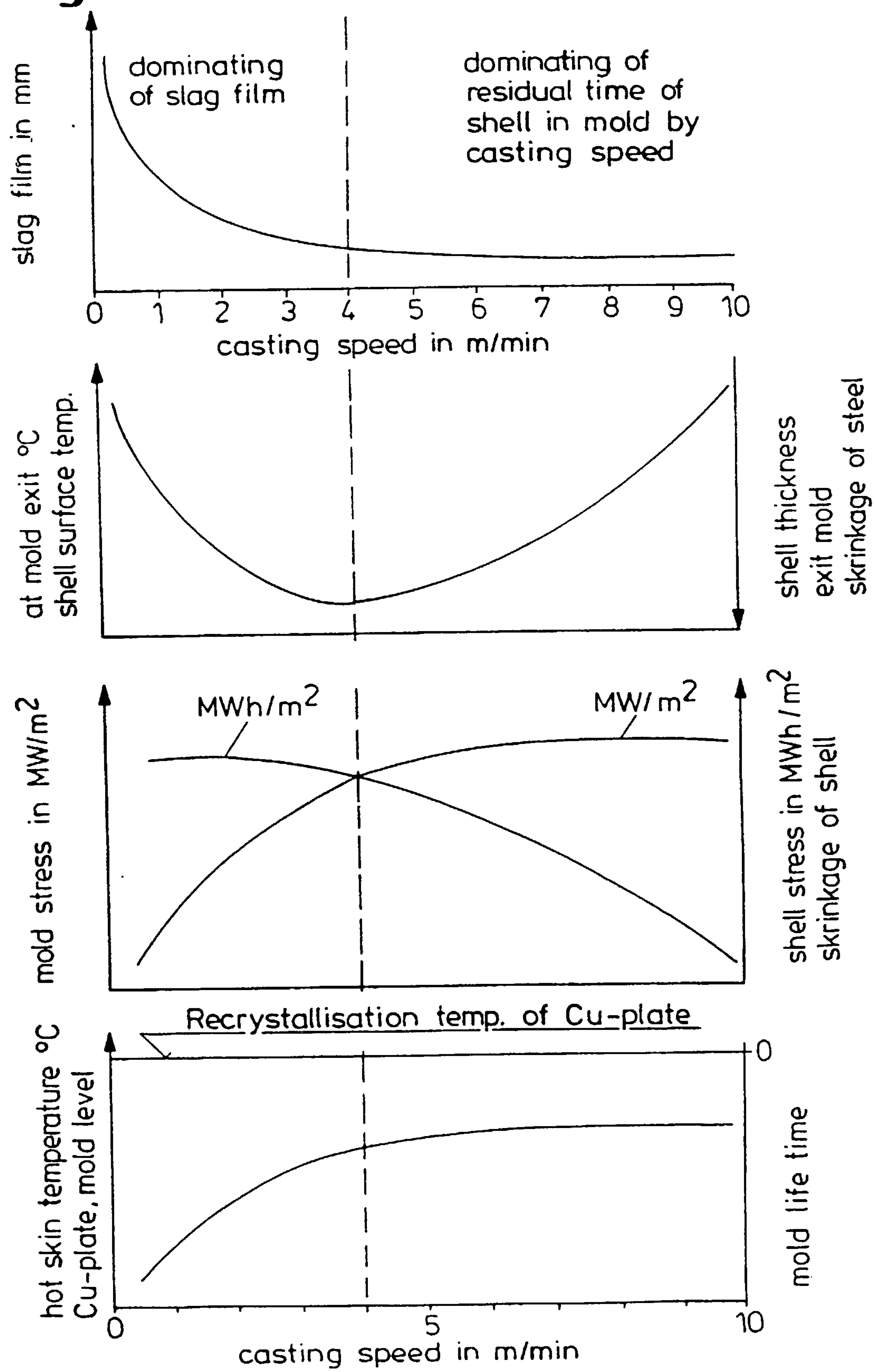
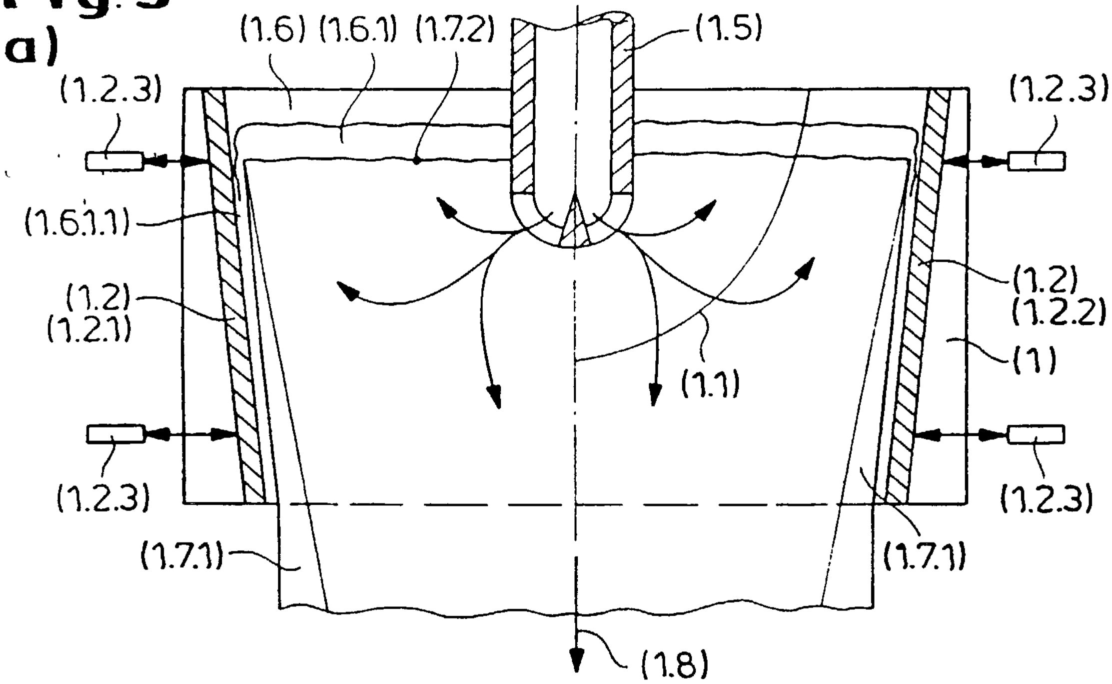
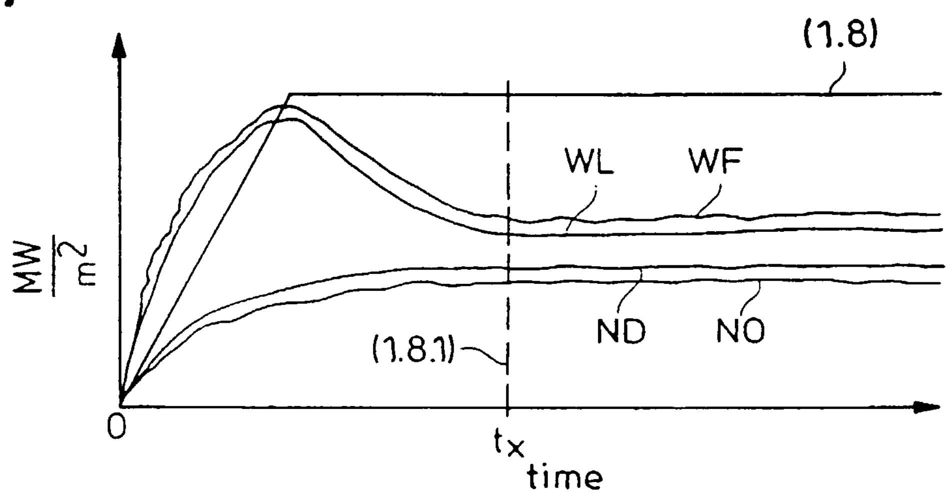

dominating
of slag film
dominating of
residual time of
shell in mold by
casting speed
slag film in mm
0
1
2
3
4
5
6
7
8
9
10
casting speed in m/min
at mold exit °C
shell surface temp.
shell thickness
exit mold
skrinkage of steel
MWh/m2
MW/m2
mold stress in MW/m2
shell stress in MWh/m2
skrinkage of shell
Recrystallisation temp. of Cu-plate
0
hot skin temperature °C
Cu-plate, mold level
mold life time
0
5
10
casting speed in m/min

Fig. 3

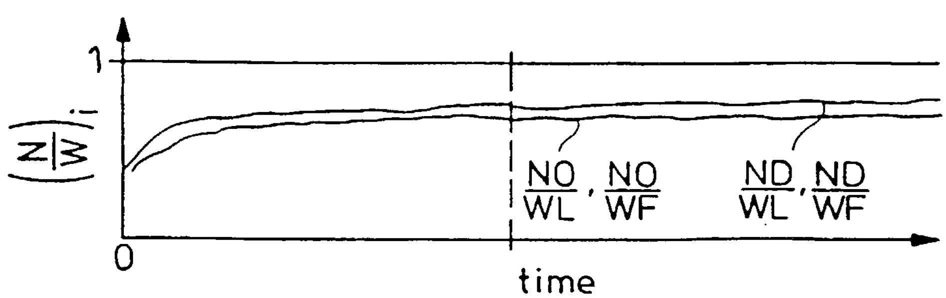
a)


(1.6) (1.6.1) (1.7.2)
(1.5)
(1.2.3)
(1.6.1.1)
(1.2)
(1.2.1)
(1.2.2)
(1)
(1.1)
(1.7.1)
(1.8)

b)


(1.8)
WL
WF
MW/m2
ND
NO
(1.8.1)
0
tx
time

c)


1
(N/W)i
NO/WL, NO/WF
ND/WL, ND/WF
0
time

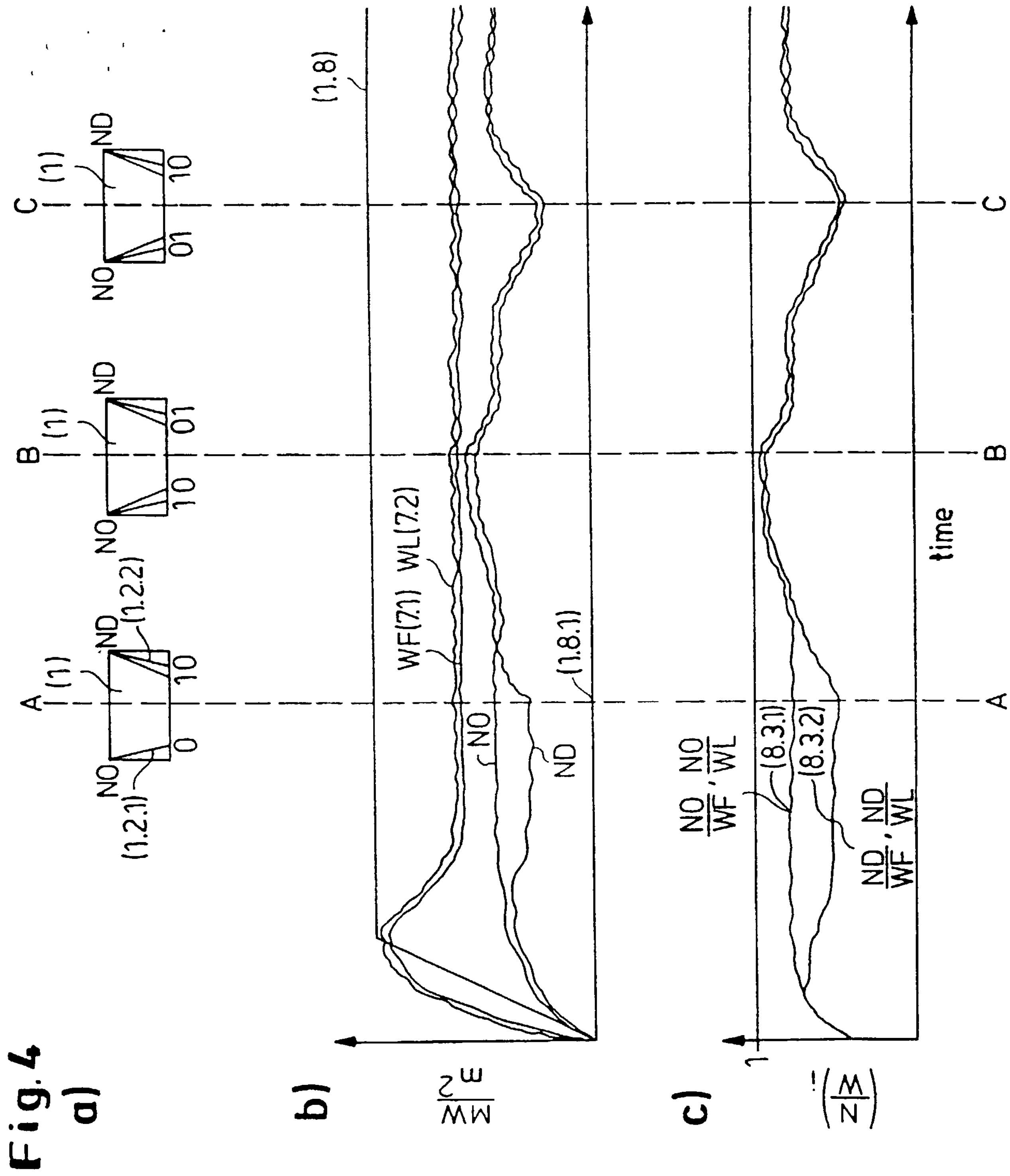

a)
A
B
C
(1)
NO
ND
(1.2.1)
(1.2.2)
0
10
01
b)
$\frac{MW}{m^2}$
(1.8)
(1.8.1)
WF(7.1)
WL(7.2)
NO
ND
c)
$\left(\frac{W}{N}\right)!$
1
$\frac{NO}{WF}, \frac{NO}{WL}$
$\frac{ND}{WF}, \frac{ND}{WL}$
(8.3.1)
(8.3.2)
time

Fig. 4

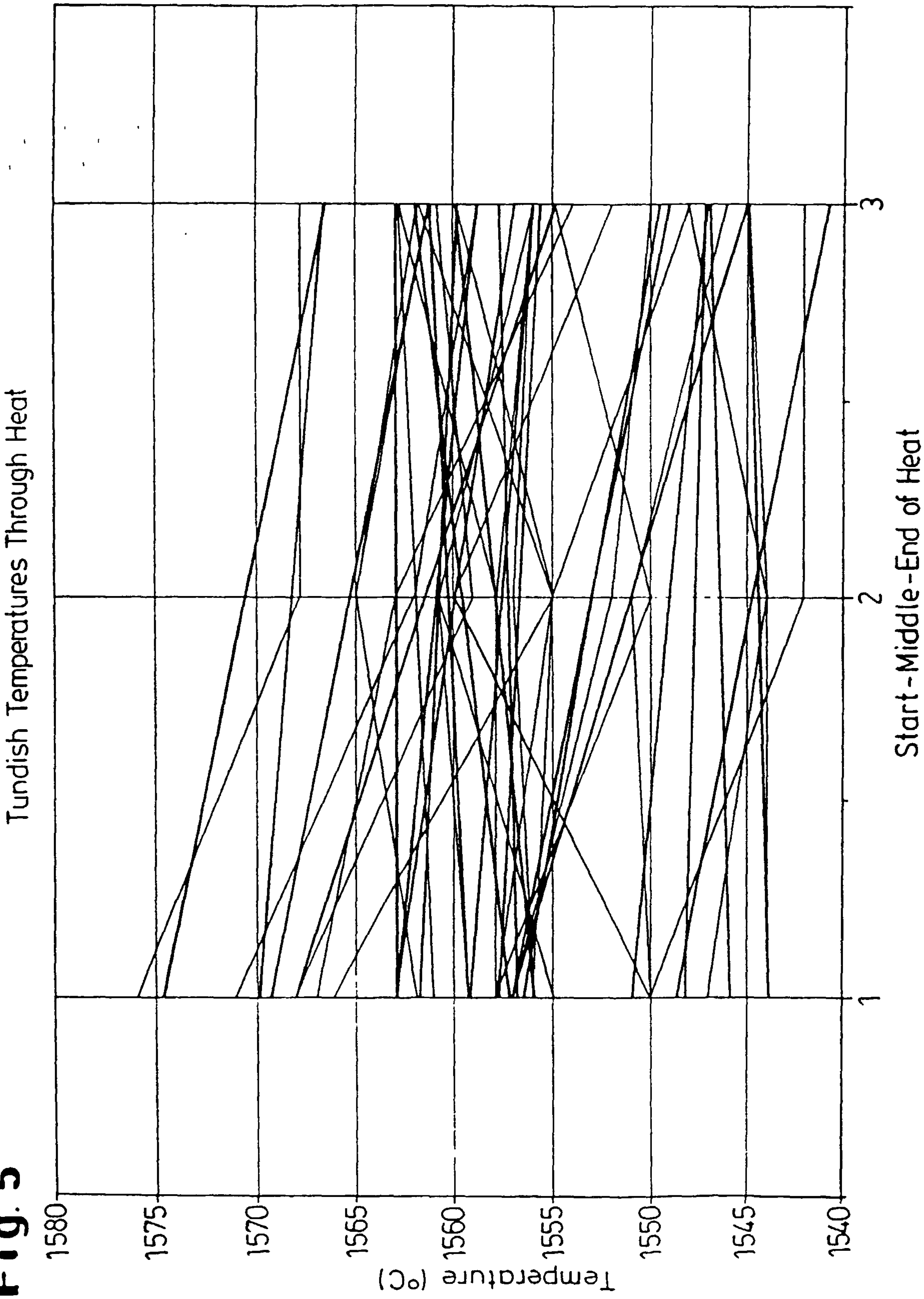

Tundish Temperatures Through Heat
Start-Middle-End of Heat
1
2
3
Temperature (°C)
1580
1575
1570
1565
1560
1555
1550
1545
1540

Fig. 5

Fig. 6

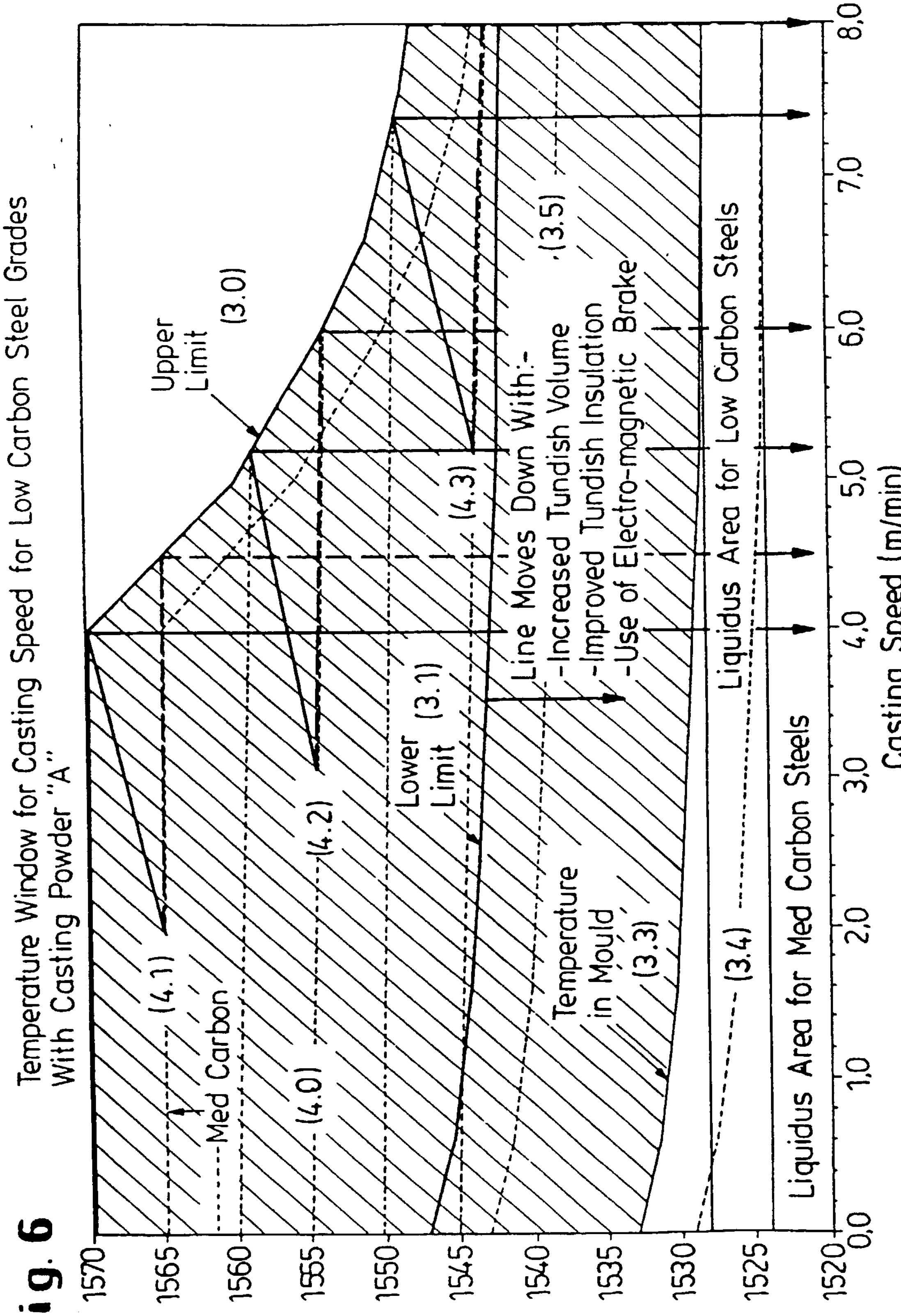
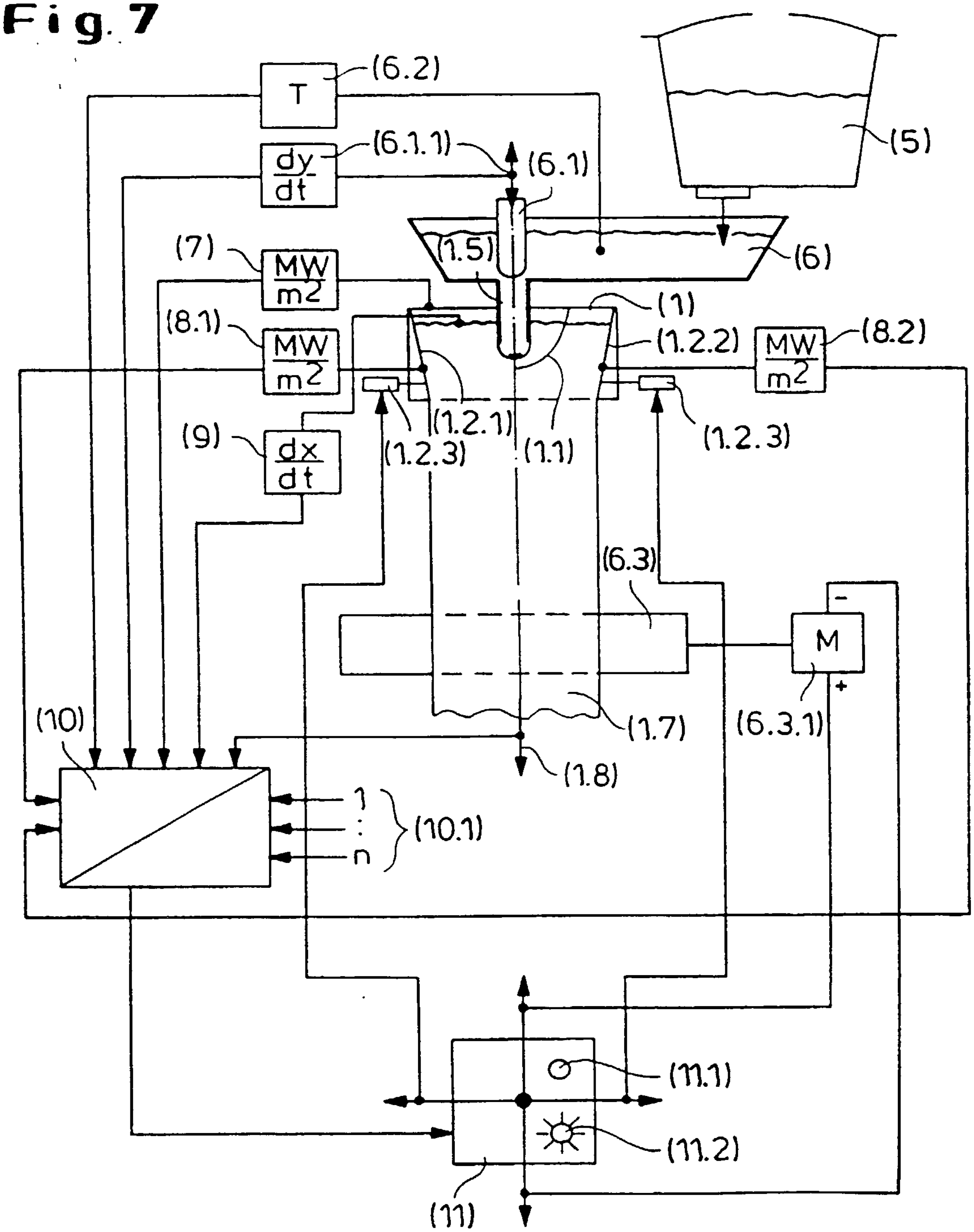

Temperature Window for Casting Speed for Low Carbon Steel Grades
With Casting Powder "A"
Upper Limit
(3.0)
Lower Limit
(3.1)
(3.3)
(3.4)
(3.5)
(4.0)
(4.1)
(4.2)
(4.3)
Med Carbon
Temperature in Mould
Line Moves Down With:-
-Increased Tundish Volume
-Improved Tundish Insulation
-Use of Electro-magnetic Brake
Liquidus Area for Low Carbon Steels
Liquidus Area for Med Carbon Steels
Casting Speed (m/min)
Temperature in Tundish (°C)
1570
1565
1560
1555
1550
1545
1540
1535
1530
1525
1520
0,0
1,0
2,0
3,0
4,0
5,0
6,0
7,0
8,0

Fig. 7


(6.2)
T
dy/dt
(6.1.1)
(6.1)
(5)
(6)
(1.5)
(7)
MW/m2
(1)
(8.1)
MW/m2
(1.2.2)
MW/m2
(8.2)
(1.2.1)
(1.2.3)
(1.2.3)
(1.1)
(9)
dx/dt
(6.3)
M
(6.3.1)
(1.7)
(10)
(1.8)
1
:
n
(10.1)
(11.1)
(11.2)
(11)

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY *(includes Reference to PCT International Applications)*	Attorney's Docket No. **BM-463PCT**

39991

As a below named inventor, We hereby declare that:
Our residence, post office address and citizenship are as stated below next to our name,

We believe we are the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **AUTOMATION OF A HIGH-SPEED CONTINUOUS CASTING PLANT**

the specification of which (check only one item below):

[ ] is attached hereto.

[ ] was filed as United States application

Serial No. ______
on ______,
and was amended
on ______ (if applicable).

[X] was filed as PCT international application

Number **PCT/EP00/05216**
on **June 7, 2000**,
and was amended under PCT Article 19
on ______ (if applicable).

We hereby state that we have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. We acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

We hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY *(if PCT, indicate PCT)*	APPLICATION NUMBER	DATE OF FILING *(day, month, year)*	PRIORITY CLAIMED UNDER 35 USC 119
GERMANY	**199 25 713.2**	**7 June 1999**	[X] YES [ ] NO
			[ ] YES [ ] NO

PTO-1391 (REV. 10-83) U.S. DEPARTMENT OF COMMERCE - Patent and Trademark Office

Combined Declaration For Parent Application and Power of Attorney (Continued) *(includes Reference to PCT International Applications)*	Docket No. HM-463

We hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of the application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, We acknowledge the duty of disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application(s) and the national or PCT interntion filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS			STATUS(CHECK ONE)		
U.S. APPLICATION NUMBER	U.S. FILING DATE		PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NO.			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(List name and registration number)*

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PTO-1391 (REV 10-83)

U.S. DEPARTMENT OF COMMERCE - Patent and Trademark Office

(7) Over

Combined Declaration For Parent Application and Power of Attorney (Continued)
(includes Reference to PCT International Applications)

Docket No. **HM-463**

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Combined Declaration For Parent Application and Power of Attorney (Continued) *(includes Reference to PCT International Applications)*	Docket No. **HM-463**

We hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE OF INVENTOR 201 [illegible]	*SIGNATURE OF INVENTOR 202* [illegible]	*SIGNATURE OF INVENTOR 203* [illegible]
DATE 30.11.2001	*DATE* 5.2.2002	*DATE* 30.11.2001
SIGNATURE OF INVENTOR 204 [illegible]	*SIGNATURE OF INVENTOR 205* [illegible]	*SIGNATURE OF INVENTOR 206* R. V. [illegible]
DATE 27.04.2002	*DATE* 14.12.2001	*DATE* 11.3.2002.
SIGNATURE OF INVENTOR 207 [illegible]		
DATE 17.12.2001		

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